

## Three New Depressed-bodied Water Skinks of the Genus *Tropidophorus* (Lacertilia: Scincidae) from Thailand and Vietnam

TSUTOMU HIKIDA<sup>1\*</sup>, NIKOLAI L. ORLOV<sup>2</sup>, JARUJIN NABHITABHATA<sup>3</sup>,  
AND HIDETOSHI OTA<sup>4</sup>

<sup>1</sup> Department of Zoology, Graduate School of Science, Kyoto University, Sakyo, Kyoto 606-8502, JAPAN

<sup>2</sup> Zoological Institute, Russian Academy of Sciences, Universitetskaya Nab. 1, St. Petersburg 199034, RUSSIA

<sup>3</sup> Thailand Natural History Museum, National Science Museum, Technopolis, Khlong 5, Khlong Luang, Pathumthani 12120, THAILAND

<sup>4</sup> Tropical Biosphere Research Center, University of the Ryukyus, Nishihara, Okinawa 903-0213, JAPAN

**Abstract:** Three new species of the genus *Tropidophorus*, characterized by distinct depression of body, strongly keeled lateral body scales, and saxicolous habits, are described from Indochina. Of these, two moderately depressed species, one with undivided frontonasal and widened paravertebral scales, and the other with divided frontonasal and unwidened paravertebral scales, were collected from small areas in northeastern and eastern Thailand, respectively. The remaining species with extremely depressed head and body was found from one limited area in northern Vietnam. The three species most resemble *T. baviensis* Bourret, 1939 from northern Vietnam among the known congeneric species in body size, body shape, and scutellation. However, body depression in *T. baviensis* is not so prominent as in the present three species. Considering that most specimens of these species were collected from rock crevices, their characteristic body shapes may represent certain stages of adaptation to life in crevices.

**Key words:** *Tropidophorus*, Scincidae, Thailand, Vietnam, New species, Taxonomy, Body depression, Rock crevices

### INTRODUCTION

*Tropidophorus* is a group of approxi-

mately 20 species of small to moderate sized lygosomine skinks distributed in Bangladesh, southern China, and Southeast Asia including the Philippines (Welch et al., 1990; Wen, 1992). This genus is characterized by superficial location of the tympanum, and most of its species are known to prefer semiaquatic

---

\* Corresponding author. Tel: +81-75-753-4091; Fax: +81-75-753-4114; E-mail address: tom@zoo.zool.kyoto-u.ac.jp

habitats along forest streams (e.g., Taylor, 1963; Brown and Alcalá, 1980).

During recent herpetological surveys in Indochina, specimens of skinks, characterized by distinctly depressed bodies with strongly keeled lateral scales, were collected from three localities, two in Thailand and one in Vietnam (Fig. 1). These skinks possessed superficial tympanums and thus were identified as members of the genus *Tropidophorus*. They most resembled *T. baviensis* Bourret, 1939 from northern Vietnam in body size, body shape, and scutellation, but differed from the latter or any other congeneric species so far described by distinct depression of body. Also, specimens from the three localities showed substantial differences from each other in a number of morphological characters. We thus describe three new species of *Tropidophorus* on the basis of these specimens.

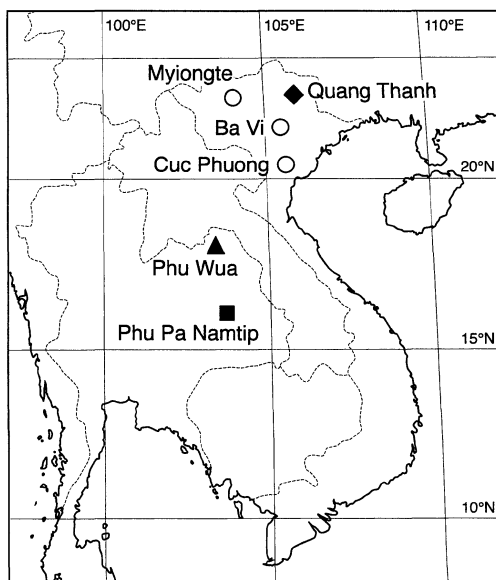


FIG. 1. Known localities of the three depressed-bodied *Tropidophorus* and *T. baviensis*. Open circles, *T. baviensis*; closed rectangle, *T. matsuii* sp. nov.; closed triangle, *T. latiscutatus* sp. nov.; and closed diamond, *T. murphyi* sp. nov.

## MATERIALS AND METHODS

The specimens, euthanized with diethyl ether or nembutal solution, were fixed with 10% buffered formalin, soaked in water, and preserved in 75% ethanol. Then measurements were taken to the nearest 0.1 mm with dial calipers. Initially all specimens were numbered according to the reference systems of the Zoological Collection, Kyoto University Museum (KUZ), and the Field Number, Royal Ontario Museum (Field No. ROM). Some of them were then moved to the Zoological Collections of Thailand Natural History Museum (TNHM), Royal Ontario Museum (ROM), Zoological Institute, Russian Academy of Sciences, St Petersburg (ZISP), and Natural History Museum of Chulalongkorn University (CUMZ).

Five specimens of *T. baviensis*, deposited in Muséum National d'Histoire Naturelle, Paris (MNHN: holotype) and ZISP were used for comparisons (see Appendix). Comparisons with the other congeneric species were made on the basis of literature descriptions (Smith, 1923, 1935; Taylor, 1963; Brown and Alcalá, 1980; Wen, 1992).

Ngo et al. (2000), in a recent redescription of *T. baviensis*, followed Peters' (1964) "Dictionary of Herpetology" in the use of terms to refer to each scale character. However, the terminology of Peters (1964) is not actually the standard for scincid squamation, and thus is not suitable for comparisons using descriptions in previous publications (Smith [1923, 1935], Taylor [1963], etc.). Therefore, we chiefly followed Taylor's (1936) terminology, which has enjoyed a far more common use in publications dealing with scincid taxonomy. The paravertebral scales were defined following Greer (1982) as middorsal scales from the posterior end of the parietals to the posterior margin of the thigh. The postsupraocular was defined as referring to a small scale posterior to the supraocular series. Of the measurements, head length was defined as the distance from the tip of the snout to the posterior margin of one of

the parietals or the interparietal (whichever was more distant). Snout length was measured from the tip of the snout to the anterior margin of the eye. Presacral vertebrae were counted by use of autoradiography (Softex, Softex Co.).

*Tropidophorus latiscutatus* sp. nov.  
(Figs. 2 and 3)

*Holotype*

Adult male, TNHM-R-60001 (KUZ R40362), from Phu Wua Wildlife Sanctuary (18°05'N,

103°45'E, altitude ca 200 m), Nong Kai Province, eastern Thailand, collected by M. Matsui, H. Ota, M. Toda, K. Araya, and J. Nabhitabhata on 21 October 1996.

*Paratypes*

Five males, TNHM-R-60002 (KUZ R40258), TNHM-R-60003 (KUZ R40370), KUZ R40256, KUZ R40377 and ZISP 22264 (KUZ R40407), and four females, TNHM-R-60004 (KUZ R40373), TNHM-R-60005 (KUZ R40257), KUZ R40259 and CUMZ R 2002.295 (KUZ R45908), from the same locality as the holo-

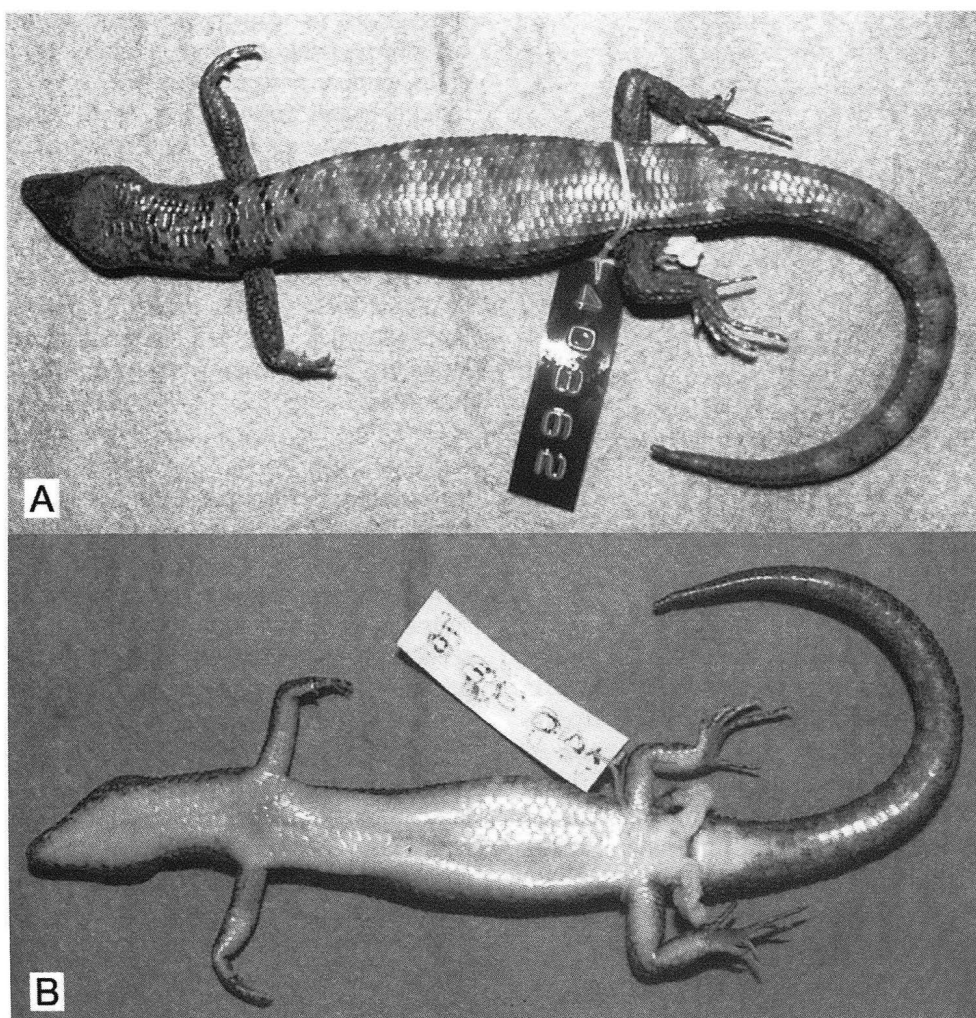


FIG. 2. Dorsal (A) and ventral (B) views of *Tropidophorus latiscutatus* sp. nov. (holotype, TNHM-R-60001).

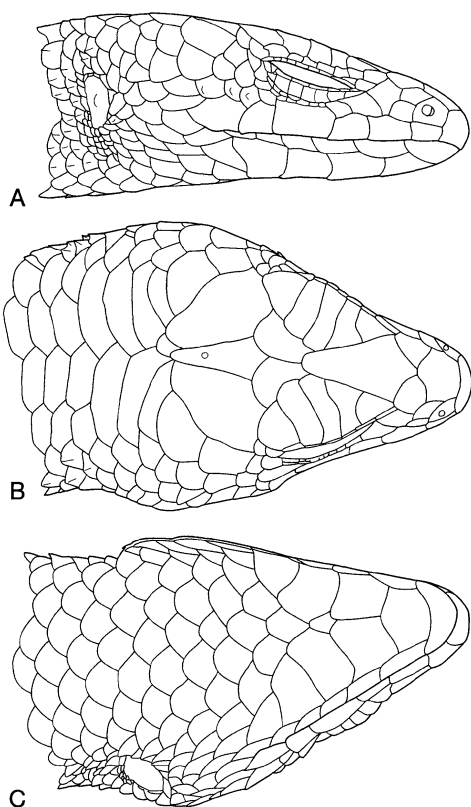


FIG. 3. Lateral (A), dorsal (B), and ventral (C) views of head scales of *Tropidophorus latiscutatus* sp. nov. (holotype, TNHM-R-60001).

type, collected from 20 to 23 October 1996.

### Diagnosis

A *Tropidophorus* with moderately depressed head, body, and tail; scales on dorsal surface of head smooth as a whole, but those in temporal region more or less keeled; frontonasal undivided; 6–7 superciliaries; paravertebral scales smooth or feebly keeled, twice as broad as neighboring scales; 58–63 paravertebral scales; dorsolateral and lateral scales distinctly keeled; usually 28 (but rarely 30) midbody scale rows. See Discussion for comparisons with other congeneric species.

### Description of holotype

Snout rounded, rostral partly visible from above; no supranasals; frontonasal undivided,

overlapped by rostral, nasals, and upper anterior loreals, and overlapping prefrontals and frontal; prefrontals separated, overlapped by frontonasal, upper anterior, and posterior loreals, and overlapping frontal, first supraoculars, and first superciliaries; frontal large, narrowing posteriorly, overlapped by frontonasal and prefrontals, and overlapping first, second, and third supraoculars and frontoparietals; supraoculars four, first one divided into upper and lower elements, overlapped by superciliaries; seven superciliaries; interparietal smaller than frontal, narrowing and slightly concave posteriorly, overlapping parietals; small transparent spot on interparietal, showing location of parietal foramen; parietals separated by interparietal; nuchals four on left, three on right, anteriormost ones separated; nostril piercing nasal; nasal overlapped by rostral and first supralabial, and overlapping frontonasal and two anterior loreals; both anterior loreals overlapped by nasal, and overlapping posterior loreal; lower anterior loreal overlapping upper one, and very slightly overlapped by second supralabial, contacting first supralabial at point; supralabials six, three anterior to, one just beneath, and two posterior to orbit; shallow groove running on loreal-labial border, posteriorly crossing subocular in obliquely downward direction; two presuboculars, anterior one larger than posterior one, overlapped by posterior loreal and supralabials; lower eyelid with seven scales, separated from labials by two or three rows of granular scales; postocular single, overlapped by fourth supraocular and palpebrals, overlapping postsuboculars; postsupraocular overlapped by fourth supraocular and postocular, and overlapping parietal and primary temporal; postsuboculars four, first one overlapped by fourth supralabial, and overlapping fifth supralabial; temporals in seven rows, those in secondary and tertiary rows more or less enlarged, the uppermost row largest, and overlapped by parietal; temporals in the other rows as large as body scales; tympanum superficial; mental overlapping first

infralabials and postmental; postmental undivided, overlapped by mental and first infralabials, and overlapping first pair of chinshields; chinshields in three pairs, first left one overlapped by first right one, second pair separated by single scale, and third pair separated by three scales; five infralabials; 28 midbody scale rows; 13 scale rows at position of tenth subcaudal on tail; paravertebral scales 59, twice as broad as neighboring scales, smooth or feebly keeled on body and base of tail, and distinctly keeled on the remaining portion of tail; scales in row adjacent to paravertebral row on each side, weakly keeled on neck, body and tail; dorsolateral and lateral scales distinctly keeled; eight rows of midventral scales smooth, scales in outer row on each side feebly keeled; preanals two, enlarged, right overlapped by left; subcaudals smooth, first one four times as broad as neighboring scales, remaining ones only two times as broad as neighboring keeled scales; scales on forelimbs keeled, those on hindlimbs keeled dorsally, but smooth ventrally; 18–20 subdigitals on fourth toe. Presacral vertebrae 26.

Testes enlarged, 9.2 mm in longer axis; epididymides regressed.

#### *Measurements of holotype (mm)*

Snout-vent length (SVL), 91.3; tail length, 96.0 (21.0 in regenerated portion); snout to forelimb length, 33.5; head length, 16.4; head width, 13.7; head depth, 8.1; snout length, 6.2; eye length, 5.2; eye to tympanum length, 7.7; snout to tympanum length, 18.0; tympanum height, 3.3; tympanum width, 2.7; axilla to groin length, 48.3; midbody width, 18.0; midbody depth, 8.5; forelimb length, 24.3; hindlimb length, 32.4; fourth toe length, 11.2.

#### *Color in preservative*

Dark brown on dorsal and lateral surfaces of head, body, and tail; two, nine, and ten transverse bands, pale brown in color and rather irregular in shape, on dorsal surfaces of neck, body, and tail, respectively; several

pale brown spots on supralabials and infralabials; yellowish ivory on gular, and ventral surfaces of body and proximal portion of tail; distal portion of tail brownish yellow ventrally.

#### *Color in life*

Dorsal and lateral surfaces somewhat darker than after preservation (see above).

#### *Variation*

Of paratypes, four adult males and two adult females measured 82.1–94.3 and 93.8–102.0 mm in SVL, respectively, whereas SVLs in three immature females ranged from 60.2 to 66.4 mm. The number of paravertebrals varied from 59 to 63 in males and from 58 to 62 in females. The number of midbody scale rows was 28 in eight paratypes, but 30 in the one remaining paratype. Upper and lower anterior loreals were fused on one side in two specimens, and on both sides in one specimen. Nuchals were in two or three pairs in paratypes. Supralabials were invariably six. Infralabials were usually five, but rarely six or four. Superciliaries were usually seven, but rarely six. In paratypes, first supraocular was not divided as in holotype. Frontal contacted usually two, but rarely three supraoculars. The number of subdigitals ranged from 18 to 22. The number of scale rows on tail at position of tenth subcaudal was usually 13, but rarely 14 or 15. In two male paratypes, portions pale brown in preservative were somewhat reddish in life. Such a reddish tint was not recognized in the other individuals in life.

#### *Etymology*

The name is derived from the Latin words, *latus* (broad) and *scutum* (scale), referring to the distinctly widened paravertebral scales characteristic of this species.

#### *Natural history*

Most specimens, including the holotype, were found in the daytime in crevices of a few large rocks and outcrops on the weak

slope of a flattened sandstone hill. Though surrounded by relatively dry open forest, the substrates beneath these rocks and outcrops were marshy, and the insides of the crevices at their lower portions (<20 cm), from which the skinks were collected, were highly moist and partially wet. Crevices at higher portions were less moist and occasionally occupied by other lizards, such as *Mantheyus phuwanensis* and *Cyrtodactylus* spp. In the evening (after sunset), two *T. latiscutatus* were found active on the ground near one of those

rocks, and this suggests that this species is nocturnal.

*Tropidophorus matsuii* sp. nov.

Figs. 4 and 5

*Holotype*

Adult male, TNHM-R-60006 (KUZ R40540), from Phu Pa Namtip (15°53'N, 104°18'E, altitude 350 m), Roi Et Province, eastern Thailand, collected by M. Toda and K. Araya on 25 October 1996.

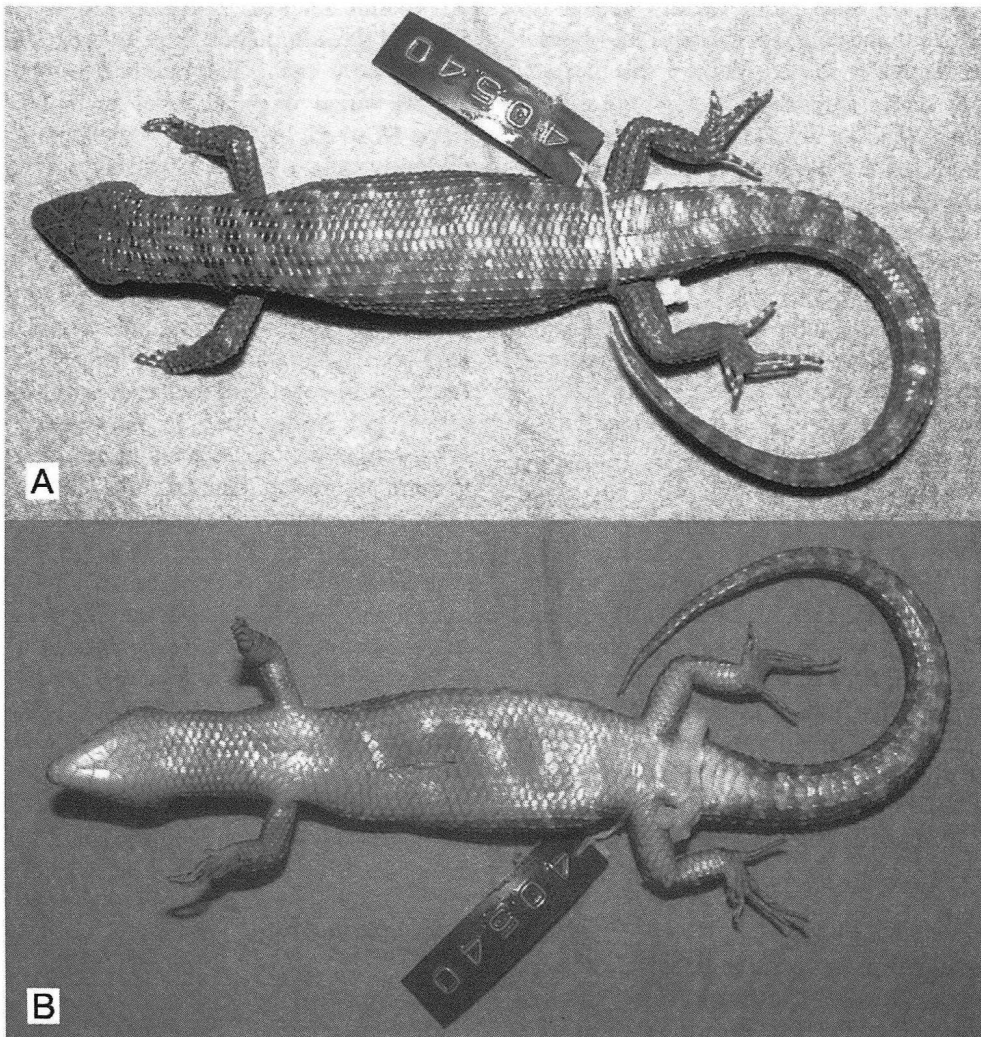


FIG. 4. Dorsal (A) and ventral (B) views of *Tropidophorus matsuii* sp. nov. (holotype, TNHM-R-60006).

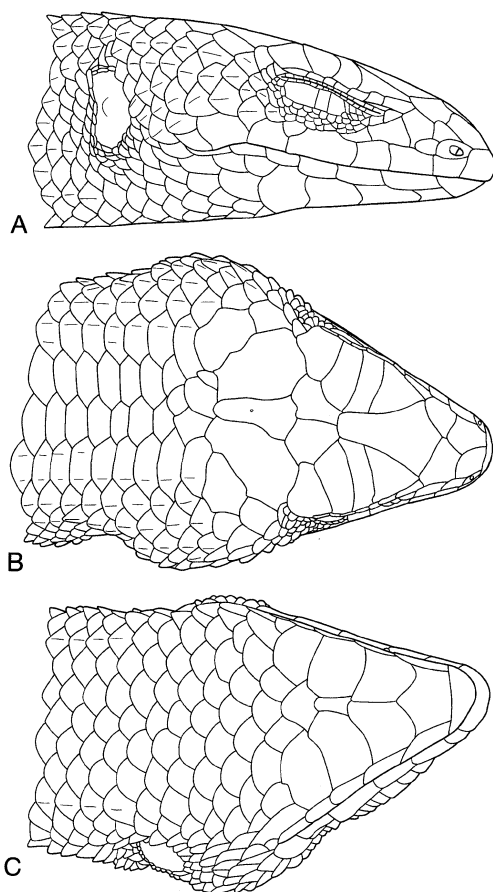


FIG. 5. Lateral (A), dorsal (B), and ventral (C) views of head scales of *Tropidophorus matsuii* sp. nov. (holotype, TNHM-R-60006).

#### *Paratypes and other specimens*

None.

#### *Diagnosis*

A *Tropidophorus* with moderately depressed head, body, and tail; scales on dorsal surface of head smooth as a whole, but those in temporal region keeled; frontonasal divided; eight superciliaries; paravertebral scales smooth or feebly keeled, subequal to neighboring scales in size; 65 paravertebral scales; dorso-lateral and lateral scales distinctly keeled; 34 midbody scale rows. See Discussion for comparisons with other congeneric species.

#### *Description of holotype*

Snout rounded, rostral partly visible from above; no supranasals; frontonasal divided with right element smaller than left one, overlapped by rostral, nasals, and upper anterior loreals, and overlapping prefrontals; prefrontals overlapped by frontonasals, upper anterior, and posterior loreals, and overlapping frontal, first supraoculars, and first superciliaries; right prefrontal narrowly overlapped by left one; frontal large, narrowing posteriorly, overlapped by prefrontals, and overlapping first and second supraoculars and frontoparietals; supraoculars four, overlapped by superciliaries; eight superciliaries; interparietal smaller than frontal, narrowing and slightly concave posteriorly, and overlapping parietals; small transparent spot on interparietal, showing location of parietal foramen; parietals separated by interparietal; nuchals lacking; nostril piercing nasal; nasal overlapped by rostral and first supralabial, and overlapping frontonasal and two anterior loreals; both anterior loreals overlapped by nasal, and overlapping posterior loreal; lower anterior loreal overlapping upper anterior loreal and very slightly second supralabial, and contacting first supralabial at point; upper anterior loreal overlapping frontonasal and prefrontal; supralabials six, three anterior to, one just beneath, and two posterior to orbit; shallow groove running on loreal-labial border, posteriorly crossing subocular in obliquely downward direction; two presuboculars, anterior one larger than posterior one, overlapped by posterior loreal and supralabials; lower eyelid with six scales, posterior three extremely enlarged, separated from labials by three rows of granular scales; three small postoculars, overlapped by fourth supraocular and palpebrals, and overlapping postsuboculars; postsupraocular overlapped by fourth supraocular and postoculars, and overlapping parietal, primary temporal, and postsuboculars; postsuboculars five, first one smooth, overlapped by fourth supralabial and overlapping fifth supralabial, remaining four postsuboculars keeled; temporals in seven



rows, those in secondary and tertiary rows more or less enlarged, uppermost rows largest, smooth, overlapped by parietal, the others smaller, keeled; temporals in the other rows keeled, subequal to body scales in size, upper ones directed straight backward, lower ones directed obliquely downward; tympanum superficial; mental overlapping first infralabials and postmental; postmental undivided, overlapped by mental and first infralabials, and overlapping first chinshields; chinshields in three pairs, first right one overlapping first left one, second pair separated by single scale, third pair separated by three scales; six infralabials; one postgenial following each of third chinshields; 34 midbody scale rows; 15 scale rows at position of tenth subcaudal on tail; paravertebrals 65, subequal in size to neighboring scales, with two very weak keels on neck, smooth on body and base of tail, and with one moderate keel on the remaining portion of tail; scales in row adjacent to paravertebral row on each side with two weak keels on neck, and with single weak keel on body and tail; dorsolateral and lateral scales distinctly keeled; eight rows of mid-ventral scales smooth, scales in outer row on each side feebly keeled; preanals two, enlarged, right one overlapped by left one; subcaudals smooth anteriorly, weakly keeled posteriorly, first one four times as broad as neighboring scales, remaining ones only two times as broad as neighboring keeled scales; scales on ventral surfaces of hindlimbs only feebly keeled, those on the other portions of hindlimbs and on forelimbs distinctly keeled; 22–23 subdigitals on fourth toe. Presacral vertebrae 26.

Testes regressed, 6.6 mm in longer axis; epididymides regressed.

#### *Measurements of holotype (mm)*

SVL, 94.1; tail length, 113.0; snout to forelimb length, 34.2; head length, 15.9; head width, 14.7; head depth, 8.9; snout length, 6.1; eye length, 5.5; eye to tympanum length, 7.6; snout to tympanum length, 18.0; tympanum height, 3.6; tympanum width, 2.2;

axila to groin length, 50.2; midbody width, 20.1; midbody depth, 9.6; forelimb length, 26.1; hindlimb length, 35.7; fourth toe length, 11.0.

#### *Color in preservative*

Dark brown on dorsal and lateral surfaces of head, body, and tail; three, nine, and 23 transverse bands, pale brown in color and somewhat irregular in shape, on dorsal surfaces of neck, body, and tail, respectively; several irregular pale brown spots on lateral sides of body (Fig. 2); several pale brown spots on supralabials and infralabials; yellowish ivory on gular and venter; ventral surface of tail yellowish ivory with indistinct dark flecks.

#### *Color in life.*

Dorsal and lateral surfaces slightly darker than after preservation; portions light brown in preservative (see above) with somewhat orange tint.

#### *Etymology*

The name is dedicated to Prof. Masafumi Matsui of Kyoto University, the project leader of the herpetological survey in Thailand, during which the present species was discovered.

#### *Natural history*

The single type specimen was found in a crevice of the lower portion of a sandstone outcrop, surrounded by relatively humid evergreen forest. Two gekkonid lizards, *Cyrtodactylus papollionoides* and *Gekko petricolus*, were also found in crevices of sandstone rocks near the collecting site.

#### *Tropidophorus murphyi* sp. nov. (Figs. 6–8)

#### *Holotype*

Adult male, ROM 41227 (ROM field No. 27044), from Quang Thanh Village (22°37'43 N, 105°54'46 E, altitude 700–750 m), Nguyen Binh District, Cao Bang



Province, northern Vietnam, collected by R. W. Murphy, N. L. Orlov, A. Lathrop, T. Mason, S. Riabov, and T. C. Ho in May 1998.

#### *Paratypes*

Four males, ROM 41220 (ROM Field No. 26739), 41222 (Field No. 26960), 41223 (Field No. 26961) and 41226 (Field No. 27002), and seven females, ROM 41221 (ROM Field No. 26959), 41224 (Field No.

27000), 41225 (Field No. 27001), 41228 (Field No. 27045), 41229 (Field No. 27058), 41230 (Field No. 27059) and KUZ R58270 (Field No. 27003), with same sampling data as the holotype.

#### *Diagnosis*

A *Tropidophorus* with extremely depressed head, body, and tail; head scales smooth on dorsal surface, but rugose on lateral surfaces; frontonasal undivided; 6–8 superciliaries;

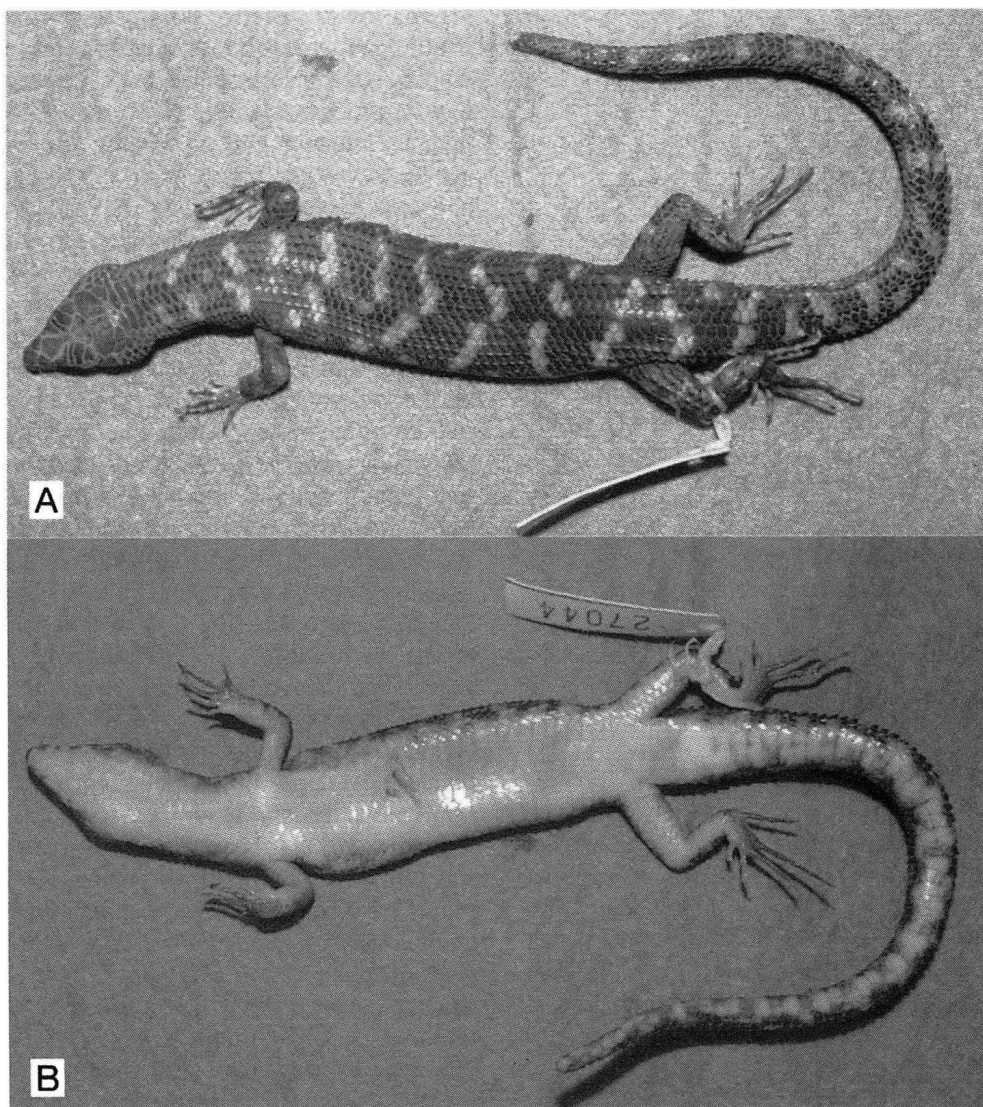


FIG. 6. Dorsal (A) and ventral (B) views of *Tropidophorus murphyi* sp. nov. (holotype, ROM 41227).

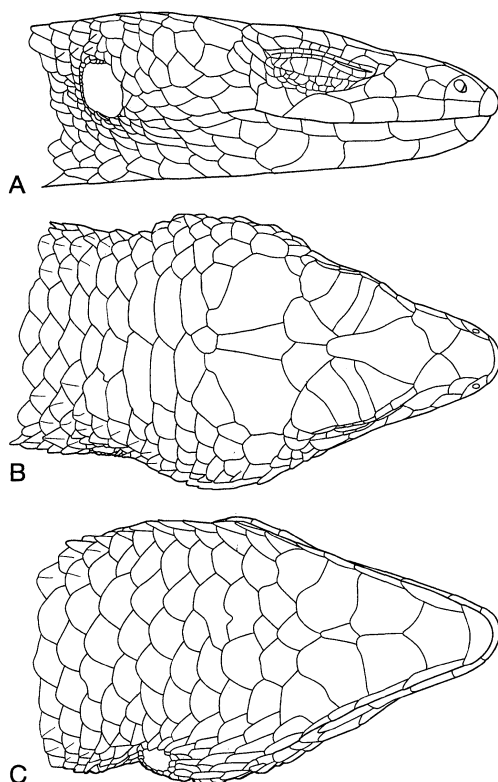


FIG. 7. Lateral (A), dorsal (B), and ventral (C) views of head scales of *Tropidophorus murphyi* sp. nov. (holotype, ROM 41227).

paravertebral scales smooth or feebly keeled, subequal to neighboring scales in size; 55–67 paravertebral scales; dorsolateral and lateral scales distinctly keeled; 30–32 midbody scale rows. See Discussion for comparisons with other congeneric species.

#### *Description of holotype*

Snout rounded, rostral partly visible from above; no supranasals; frontonasal undivided, overlapped by rostral, nasals, and upper anterior loreals overlapping prefrontals; prefrontals contacting each other at point, overlapped by frontonasals, upper anterior and posterior loreals, and overlapping frontal, first supraoculars, and first superciliaries; frontal large, narrowing posteriorly, overlapped by prefrontals, and overlapping first and second supraoculars and frontopa-

rietals; supraoculars four, overlapped by superciliaries; superciliaries six in left, seven in right; interparietal smaller than frontal, narrowing and slightly concave posteriorly, overlapping parietals; small transparent spot on interparietal, showing location of parietal foramen; parietals separated by interparietal; three pairs of nuchals; nostril piercing nasal; nasal overlapped by rostral and first supralabial, and overlapping frontonasal and two anterior loreals; both anterior loreals overlapped by nasal, and overlapping posterior loreal; lower anterior loreal very slightly overlapped by second supralabial, and overlapping upper anterior loreal, but not contacting first supralabial; upper anterior loreal overlapping frontonasal and prefrontal; supralabials six, three anterior to, one just beneath, and two posterior to orbit; shallow groove running on loreal-labial border, posteriorly crossing subocular in obliquely downward direction; two presuboculars, anterior one larger than posterior one, overlapped by posterior loreal and supralabials; lower eyelid with seven scales, separated from labials by two or three rows of granular scales; two postoculars, overlapped by fourth supraocular and palpebrals, and overlapping postsuboculars; postsupraocular overlapped by fourth supraocular and postoculars, and overlapping parietal and primary temporal; postsuboculars four, smooth, first one overlapped by fourth supralabial, and overlapping fifth supralabial; temporals in seven rows, those in secondary and tertiary rows more or less enlarged, uppermost secondary temporal divided, overlapped by parietal together with uppermost tertiary temporal; temporals in the other rows subequal to body scales in size; tympanum superficial; mental overlapping first infralabials and postmental; postmental undivided, overlapped by mental and first infralabials, and overlapping first chinshields; chinshields in three pairs, first right one overlapped by first left one, second pair separated by single scale, third pair separated by three scales; five infralabials; one scale broadly overlapping third left chinshield, and

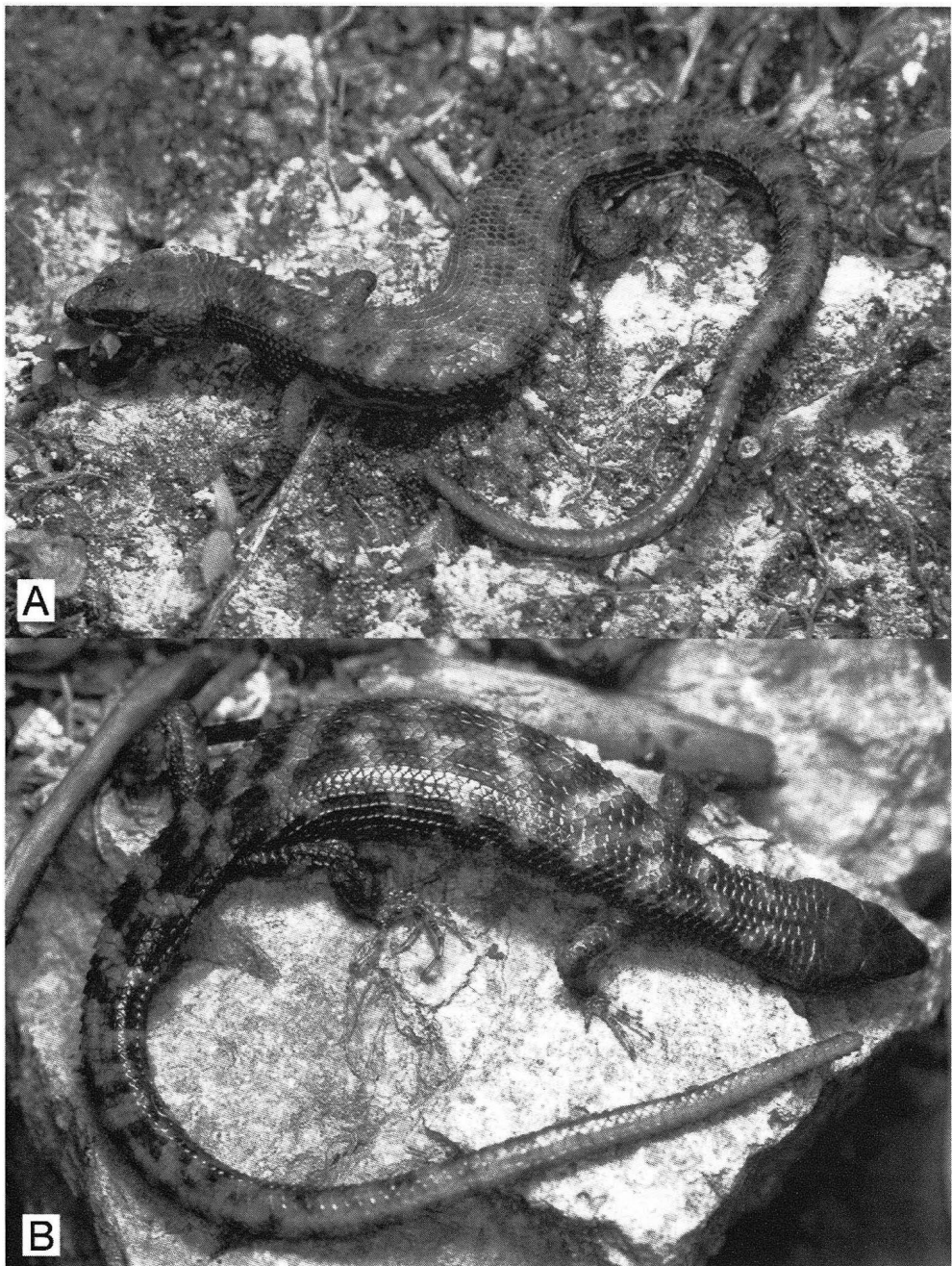


FIG. 8. Male (A) and female (B) *Tropidophorus murphyi* sp. nov. in life. Note relatively broad body in the latter.

overlapped by fourth and fifth infralabials; 30 midbody scale rows; 13 scale rows at position of tenth subcaudal on tail; paraver-

tebrals 62, subequal in size to neighboring scales, smooth or feebly keeled on neck, body, and base of tail, and moderately keeled on

the remaining portion of tail; scales in row adjacent to paravertebral row on each side weakly keeled on neck, body and tail; dorsolateral and lateral scales distinctly keeled; six rows of mid-ventral scales smooth, scales in outer row on each side feebly keeled; preanals two, enlarged, right one overlapped by left one; subcaudals smooth, four times as broad as neighboring scales, remaining ones only two times as broad as neighboring keeled scales; scales on ventral surfaces of hindlimbs only feebly keeled, those on the other portions of hindlimbs and on forelimbs distinctly keeled; 24 subdigitals on fourth toe. Presacral vertebrae 26.

Left testis 4.7 mm in longer axis.

#### *Measurements of holotype (mm)*

SVL, 85.1; tail length, 101.0 (tail tip lost); snout to forelimb length, 30.5; head length, 14.3; head width, 12.3; head depth, 6.4; snout length, 5.7; eye length, 5.0; eye to tympanum length, 6.5; snout to tympanum length, 16.7; tympanum height, 3.1; tympanum width, 2.3; axila to groin length, 42.8; midbody width, 14.7; midbody depth, 5.5; forelimb length, 22.9; hindlimb length, 33.0; fourth toe length 11.7.

#### *Color in preservative*

Dark brown or dorsal and lateral surfaces of head, body, and tail; three, seven, and 17 transverse bands, pale brown in color and rather irregular in shape, on dorsal surfaces of neck, body, and tail, respectively; several pale brown spots on supralabials and infralabials; yellowish ivory on gular and venter; ventral surface of tail yellowish ivory with indistinct dark flecks.

#### *Variation*

Of paratypes, three adult males and one young male measured 62.4–85.1 mm and 55.2 mm in SVL, respectively, while SVL in five adult and two immature females ranged from 92.2 to 96.3 and from 56.1 to 76.8, respectively. Relative breadth of body was distinctly greater in adult females than in

adult males (midbody width/SVL\*100: 18.6–22.0, vs. 17.7–18.2) (Fig. 8). The paravertebral number was also greater in females than in males (mean and range: 59.6 and 60–67, vs 62.6 and 55–62). No intersexual differences were evident in other scale characters. The number of midbody scale rows ranged from 30 to 32. Upper and lower anterior loreals were fused on one side in two specimens and on both sides in one specimen. The arrangement of nuchals was highly variable, two on both sides in five specimens, none on both sides in two specimens, two on left and three on right in two specimens, two on left and none on right in one specimen, two on left and four on right in one specimen, and three on both sides in one specimen. Supralabials were invariably six. Infralabials were usually five, but rarely six. Superciliaries were usually six or seven, but rarely five or eight. Frontal contacted usually two, but rarely three supraoculars. The number of subdigitals ranged from 20 to 25. Scale rows on tail at position of tenth subcaudal were invariably 13.

#### *Etymology*

The name is dedicated to Dr. Robert W. Murphy of the Royal Ontario Museum, the project leader of the herpetological survey in Vietnam, during which the present species was discovered.

#### *Natural history*

All specimens were collected in humid rocky areas along a stream flanked by steep rocky slopes with bush. There were many moist crevices in the rocks, in which the skinks hid themselves during the daytime. Active individuals were observed only after sunset, and this strongly suggests that this species is nocturnal. Because individuals, prevented from direct contact with moist substrates, showed rapid dehydration even under high atmospheric humidity, it is likely that *T. murphyi* is highly vulnerable to drought. Another congeneric species, *T. sinicus* occurred sympatrically, but was found under

rocks closer to the stream.

Female paratypes had 3–5 eggs in oviducts, which had no recognizable embryos. A non-type female from the type locality, kept in captivity at Tula Exotarium, Russia, gave birth to a juvenile, 28 mm in SVL, on 30 March 2002. It is thus obvious that this species is viviparous like several other congeneric species (Smith, 1923; Taylor, 1963).

### DISCUSSION

Smith (1923), in a revision of the genus *Tropidophorus* from the continental region of Southeast Asia, recognized nine species. Later, *T. baviensis* and *T. guanxiensis* were described from northern Vietnam, and Guanxi, China, respectively (Bourret, 1939; Wen, 1992), making the total number of recognized continental species of *Tropidophorus* 11. Of these, *T. baviensis* most resembles *T. latiscutatus*, *T. matsuii*, and *T. murphyi* in having keeled scales on the temporal and smooth scales on the remaining dorsal and lateral surfaces of the head, and smooth or feebly keeled dorsal scales on the body. These three species, however, differ from *T. baviensis* or any other congeneric species so far described in having a distinctly depressed body. Moreover, the numbers of paravertebrals in the present species are distinctly greater than that in *T. baviensis* (Table 1).

Of the three depressed-bodied species described above, the degree of depression, particularly of the head, is much greater in *T. murphyi* than in the two Thailand species (Table 1, Fig. 9). *Tropidophorus matsuii*

differs from *T. latiscutatus* in having greater numbers of midbody scale rows and paravertebrals. Also, *T. matsuii* is distinct from *T. latiscutatus*, as well as from *T. murphyi* and *T. baviensis*, in having a divided frontonasal. *Tropidophorus latiscutatus* is distinct from the other species in having distinctly widened paravertebrals (Table 1).

Species characterized by distinctly depressed bodies have been reported for a few other lizard families, such as Gekkonidae, Iguanidae, and Xenosauridae. Because many of these species are strongly associated with saxi-

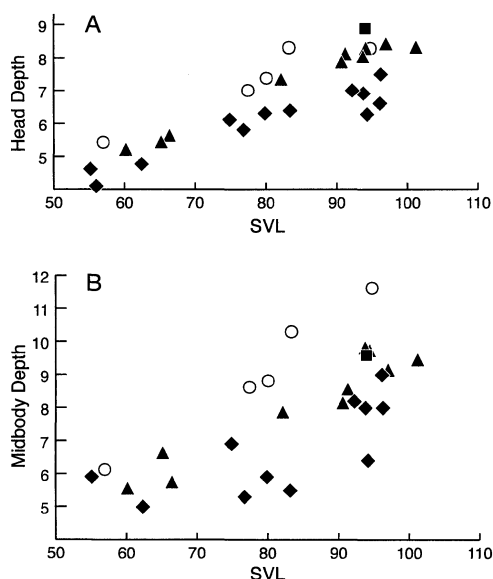


FIG. 9. Two dimensional plots of head depth (A) and depth at midbody (B) against snout-vent length (SVL), showing interspecific variations in degrees of head and body depressions, respectively. See Fig. 1 for explanations of symbols.

TABLE 1. Comparisons in external characters of the three depressed-bodied *Tropidophorus* and *T. baviensis*.

Character	<i>T. baviensis</i>	<i>T. latiscutatus</i>	<i>T. matsuii</i>	<i>T. murphyi</i>
Body depression	slight	moderate	moderate	extreme
Midbody scale rows	28–30	28–30	34	30–32
Frontonasal	undivided	undivided	divided	undivided
Paravertebral widened	no	yes	no	no
Paravertebral number	49–53	58–63	65	59–67

colous habitats, such body depression is often regarded as a kind of adaptation to the use of narrow rock crevices as shelters for predatory avoidance (Vitt, 1981; Doughty and Shine, 1995; Ballinger et al., 2000). Known members of the genus *Tropidophorus*, including *T. baviensis*, are usually found beneath rocks and leaf litter on the forest floor (occasionally close to a stream: Taylor, 1963; Brown and Alcalá, 1980), or in burrows on banks (*T. baviensis*: Ngo et al., 2000). Discovery of the three exceptionally depressed-bodied *Tropidophorus* in rock crevices, a type of habitat also exceptional to the genus, offers a first substantial support from the Scincidae for the assumption regarding the enhancement of body depression by this type of habitat.

Several authors have assumed that in lizards the physical constraint from the crevice-dwelling habits provides an evolutionary force to some reproductive traits, such as relative clutch mass and frequency of clutch production (Vitt, 1981, 1993; Doughty and Shine, 1995). However, relevant hypotheses have not yet been sufficiently assessed by appropriate comparative approaches (e.g., see Ballinger et al. [2000]). The present species and *T. baviensis*, seemingly representing differential stages of an adaptation to life in rock crevices, would offer a good opportunity to examine the evolutionary consequences of crevice-dwelling habits in reproductive and other ecological and physiological traits.

#### ACKNOWLEDGMENTS

T. Hikida and H. Ota thank M. Matsui for providing opportunities to visit Thailand, and S. Panha, M. Matsui, K. Araya, M. Toda, T. Chen, and M. Honda for helping with field work there. Likewise, N. L. Orlov is very grateful to R. W. Murphy for enabling him to make field surveys in Vietnam, and to A. Lathrop, T. Mason, Ho Thu Cuc, Nguyen Van Sang, S. Ryabov, and E. Rybalovskiy for their assistance during the field work. We are also much indebted to I. Ineich

and A. Dubois (MNHN) for allowing us to examine the type specimen of *T. baviensis* under their care, to M. Hori for facilities for autoradiography, to S. Sakata for helping with preparations of line drawings and radiographs, and to N. B. Ananjeva for various help in preparing the draft of this manuscript.

Sampling of lizards in Thailand was carried out with the permission of the National Research Council of Thailand (NRCT), Bangkok, and with financial support from a Monbuscho International Scientific Program (Field Research No. 08041144; project leader: M. Matsui). For the Vietnamese specimens, permission for collecting and exporting was obtained from the Vietnam Institute of Ecology and Biological Resource (IEBR), Hanoi.

#### LITERATURE CITED

- BALLINGER, R. E., J. A. LEMOS-ESPINAL, AND G. R. SMITH. 2000. Reproduction in females of three species of crevice-dwelling lizards (genus *Xenosaurus*) from Mexico. *Stud. Neotrop. Fauna Env.* 35(3): 179–183.
- BOURRET, R. 1939. Notes herpétologiques sur l'Indochine Française. XVII. Reptiles et Batraciens recueillis au Laboratoire des Sciences Naturelles de l'Université au cours de l'année 1938. Description de trois espèces nouvelles. *Ann. Bull. Gén. Inst. Publ.* 6: 13–34.
- BROWN, W. C. AND A. C. ALCALÁ. 1980. Philippine Lizards of the Family Scincidae. Silliman University Natural Science Monograph Series No. 2. Silliman University Press, Dumaguete. 264 p.
- DOUGHTY, P. AND R. SHINE. 1995. Life in two dimensions: natural history of the southern leaf-toed gecko, *Phyllurus platurus*. *Herpetologica* 51(2): 193–201.
- GREER, A. E. 1982. A new species of *Leiopisma* (Lacertilia: Scincidae) from Western Australia, with notes on the biology and relationships of other Australian species. *Rec. Aust. Mus.* 34(12): 549–573.
- NGO, A., R. W. MURPHY, N. ORLOV, I. DAREVSKY, AND V. S. NGUYEN. 2000. A

- redescription of the Ba Vi water skink *Tropidophorus baviensis* Bourret, 1939. Russ. J. Herpetol. 7(2): 155–158.
- PETERS, J. A. 1964. Dictionary of Herpetology. A Brief and Meaningful Description of Words and Terms Used in Herpetology. Hafner Publ., New York and London. 393 p.
- SMITH, M. A. 1923. A review of the lizards of the genus *Tropidophorus* on the Asiatic mainland. Proc. Zool. Soc. London, 1923: 775–781.
- SMITH, M. A. 1935. The Fauna of British India, Including Ceylon and Burma. Reptilia and Amphibia. II. Sauria. Taylor and Francis, London. 440 p.
- TAYLOR, E. H. 1936. A taxonomic study of the cosmopolitan scincoid lizards of the genus *Eumeces*, with an account of the distribution and relationships of its species. Univ. Kansas Sci. Bull. 24: 1–643.
- TAYLOR, E. H. 1963. Lizards of Thailand. Univ. Kansas Sci. Bull., 44(14): 687–1077.
- VITT, L. J. 1981. Lizard reproduction: habitat specificity and constraints on relative clutch mass. Am. Nat. 117(4): 506–514.
- VITT, L. J. 1993. Ecology of isolated open-formation *Tropidurus* (Reptilia: Tropiduridae) in Amazonian lowland rain forest. Can. J. Zool. 71: 2370–2390.
- WELCH, K. R. G., P. S. COOKE, AND A. S. WRIGHT. 1990. Lizards of the Orient: A Checklist. R. E. Krieger Publ. Co., Malabar, Florida. 162 p.
- WEN, Y.. 1992. A new species of the genus *Tropidophorus* (Reptilia: Lacertilia) from Guangxi Zhunag Autonomous Region, China. Asiatic Herpetol. Res. 4: 18–22.

## APPENDIX

### *Specimens examined for comparisons*

See text for institutional acronyms.

*Tropidophorus baviensis*.—MNHN 1948.63 (holotype), Mt. Ba Vi, Ha Tay Province, northern Vietnam; ZISP 22251 (N-37), Ba Vi National Park, Ha Tay Province, northern Vietnam; ZISP 19805, Cuc Phuong National Park, Hoa Binh Province, northern Vietnam; ZISP 21009-1, 21009-2, Myongte, Lai Chau Province, northern Vietnam.

---

*Accepted: 28 May 2002*